Deborah McPhedran
391 Holland Avenue
Ottawa, Ontario K1Y 0Y9

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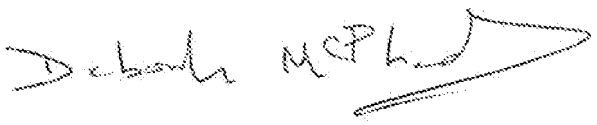
To whom it may concern:

I, Deborah McPhedran, undersigned, do hereby attest that I hold certification as a professional translator, French into English, granted by the American Translators Association (ATA) and the Association of Translators and Interpreters of Ontario (ATIO), and that my translation of the following document, the original of which is in French, is complete and accurate to the best of my ability and knowledge:

- Patent Application, entitled "Application for Patent for Invention" (publication # 2 821 151.) This is a document of 14 pages, each of which has been dated, initialed, and marked with the registration numbers for both translation accreditations mentioned above.

Sincerely yours,



Deborah McPhedran, B.Sc., C.Tran.(F>E)
ATA (www.atanet.org) membership no. 220160
ATIO (www.atio.on.ca) membership no. 2297

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(60) References to other, related national documents:

(71) Applicant(s): MANURHIN DEFENSE S.A. - FRANCE.

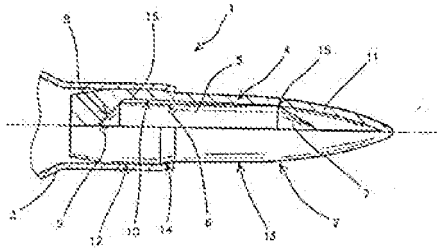
(72) Inventor(s): Jean Claude CACHER.

(73) Owner(s):

(74) Agent(s): CABINET CELANIE.

(54) PERFORATING PROJECTILE FOR SMALL OR MEDIUM-CALIBRE MUNITIONS AND ASSEMBLY PROCESS FOR SUCH A PERFORATING PROJECTILE.

(57) The subject of the invention is a perforating projectile (2) with an undercalibrated core, specifically for small or medium-calibre munitions. The perforating projectile (2) is composed of an undercalibrated perforating core (5) of a heavy material, centered and held within a jacket (4) of a ductile material. It is characterised by the fact that the jacket is crimped onto the core by the ogival extremity (11).



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The technical domain of this invention is that of perforating projectiles bearing an under-calibrated core, particularly for small or medium calibre munitions.

Such projectiles are well-known to the master of this craft. They are specifically designed to perforate the armour of armoured vehicles.

In general they consist of an undercalibrated core centered within a base, with the core/base unit covered and held by a jacket crimped to the end of the base.

The core is generally made of a heavy material with good perforation characteristics, often tungsten-based.

The jacket is generally made of a ductile material, such as a copper alloy. It is designed to accept grooving by the barrel of the arm, communicating a rotation speed sufficient to ensure its trajectory stability and to hold the core during the projectile's trajectory to impact with the target.

Patent W09741404 describes such a projectile that also includes ballast located between the end of the base and the jacket crimp.

The main disadvantage of these projectiles is their high purchase cost.

Consider that they are made of at least three parts, a base, a core and a jacket and require at least two assembly operations, namely sleeving the core on the base and crimping of the jacket to the base.

The purpose of this invention is to propose a perforating projectile that allows us to mitigate these disadvantages.

Accordingly, the perforating projectile that is the subject of this invention has only two parts, a core and an envelope.

Its design and assembly are simple and its cost moderate.

Therefore, the subject of the invention is a perforating projectile, specifically for a small or medium calibre arm, consisting of an undercalibrated perforating core made of a heavy material, centered and attached within a jacket made of a ductile material, with the projectile characterised by the fact that the jacket is crimped to the core at its ogival extremity.

Advantageously, the core can include a central cylinder extended in the forward portion by a conic point and a point in the rear portion in the shape of a truncated cone.

The jacket can include a blind conic bore.

This bore may include a conic base designed to work with the truncated cone shape of the core to center the latter within the jacket, with the conicity of the base being the same as that of the projection.

The conicity of the bore may be oriented in such a way that there is some play between the bore and the central cylinder, which increases from a connecting rib on the central cylinder and the conic point, as far as the truncated projection.

The outside of the projectile's jacket may include a cylindrical projection designed to accept grooving by the barrel of an arm, with its diameter effectively the same as the radial diameter at the base of the arm's barrel.

The outside of the jacket may include an intermediate part in the shape of a truncated cone connected to the ogival extremity, with the largest diameter of this intermediate part effectively just less than the diameter at the top of the groove of the arm's barrel.

The projection may be connected to the intermediate part in the shape of a truncated cone by a shoulder allowing the crimping of a shell case.

The core will be held tightly against the inside of the jacket by the connecting rib.

The invention also includes an assembly process for a perforating projectile, characterised in that after the placement of the core in a jacket, when the core is set back from the end of the jacket by a height H, between 1.5 and 2 times the diameter of the core, the crimping of the ogival extremity is achieved with a crimping punch tool.

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The crimping punch tool can be moved axially in relation to the jacket to a position at the end of the crimping operation established by a stop, with the tool including a rib on the external diameter of the jacket extended by an ogival profile, allowing the deformation of the jacket when the tool is applied.

The main advantage of the perforating projectile of this invention is that the core is perfectly centered within the jacket without the need for machining.

Another advantage is that the play between the core and the jacket improves the projectile's acceptance of grooving within the barrel of the arm while reducing the effort of grooving, or frictional energy, which reduces barrel wear and retains the higher kinetic energy of the projectile.

Another advantage resides in the fact that the shoulder on the outside of the jacket allows the shell case to be crimped on the projectile without having to make a crimping sleeve.

Other characteristics, details and advantages of the invention will be made clearer from the description given hereafter when seen with the drawings appended, and wherein:

- Figure 1 represents a longitudinal semi cross-section of a perforating projectile as per the invention,
- Figure 2 represents a crimping tool used to make a perforating projectile as per the invention.

In Figure 1, munitions 1 is a perforating projectile 2 as per the invention, mounted on a shell case 3.

The perforating projectile 2 consists advantageously of only two parts: a jacket 4 and an undercalibrated perforating core 5.

The core 5 is made of a heavy material with good perforation characteristics, for instance, tungsten carbide. It is obtained by sintering and no machining is necessary. This fact means that the purchase price is kept to a moderate level.

It exhibits a central cylinder 6 extended in the forward portion by a conic point 7 designed to ensure the perforation of the target and a rear portion extended in part by a projection in the shape of a truncated cone 8 designed to work with the jacket, as will be explained later.

The jacket 4, made of a ductile material, such as a copper alloy, contains the core 5. It is made by cold working and drawing using a process well-known to masters of the craft.

The jacket 4 bears a blind conical bore 10, from the top of the cone located on the front of the projectile. A conical base 9 of the bore 10 offers the same conicity as the truncated cone 8 of core 5.

The front end of the jacket 4 consists of an ogive 11.

The outside of the jacket 4 includes a cylindrical projection 12 that will accept grooving by the barrel of an arm. To achieve this, the diameter of the projection 12 is effectively equal to the diameter at the base of the arm's barrel.

The jacket 4 also has an intermediate truncated portion 13 that is connected to the ogival extremity 11. The greatest diameter of this intermediate portion 13 is effectively less than the diameter at the top of the groove of the arm's barrel.

A shoulder 14 connects the projection 12 to the intermediate portion in the shape of a truncated cone 13. This shoulder allows the advantageous crimping of the shell casing 3 to the perforating projectile 2 without the need for a crimping groove.

One specificity of the invention is that the jacket 4 is sealed by crimping on the core 5 at its ogival extremity 11.

The core 5 is therefore pressed against the interior of the jacket 4, from one side by the projection in the shape of a truncated cone 8 and from the other side by a connecting rib of the central cylinder 6 and the conic point 7. The core 5 is therefore perfectly centered and held within the jacket 4.

Annular play 16 exists between the central cylinder 6 of the core and the conical bore 10 of the jacket. This play increases from rib 15 to projection 8, and is maximized by the cylindrical projection 12.

The annular play 16 reduces the forces at cylindrical projection 12 of the jacket with the grooves of the arm's barrel during firing. Specifically, since the jacket 4 may deform by radial compression thanks to the play 16, this reduces barrel wear and also preserves the kinetic energy of the projectile.

Assembling a perforating projectile 2 according to the invention is accomplished by following a procedure to be described in reference to figure 2.

First the core 5 is placed within the jacket 4. The core is automatically centered within the jacket thanks to the portion shaped like a truncated cone 8 which works with the conical base 9 of the bore 10 of the jacket.

Next the ogival extremity 11 of the jacket 4 is crimped.

Note the advantage of a single assembly operation to put together the perforating projectile as per the invention.

Before the crimping operation, the core 5 is held away from the end of the jacket 4 by a height equal to H. It is preferred that the height H will be between 1.5 and 2 times the diameter of the core.

This height allows a closed crimping of the jacket 4 and brings the jacket and core 5 in contact with a slight crushing the jacket 4 by rib 15.

The crimping is accomplished using the appropriate tool.

The jacket with core in place is positioned on a table 21 and underneath a crimping punch tool 17. The tool 17 is attached to a rack 22 that can translate in relation to a column 23 perpendicular to the table 21. To simplify the figure, the rack 22 and the column 23 are shown schematically.

An end-run stop 18 is adjustable and attached to the column 23, allowing the minimum distance between the crimping tool 17 and the table 21 to be established, also establishing the position of the end of crimping of jacket 4.

Stop 18 works in conjunction with a counter-stop 24 built in to rack 22.

As per the invention, the crimping tool 17 includes a bore 19 on the external diameter of the jacket 4. Bore 19 is extended by an ogival profile 20 designed to allow for the deformation of the jacket 4 when the tool 17 is applied.

The ogival profile 20 ensures that the ogival form at the extremity 11 of the jacket 4 is maintained.

During the crimping operation, the jacket 4 comes into contact with the core 5 at its rib 15, which allows improvement of centering and ensures that it stays within the jacket 4. So, core 5 is perfectly centered and held within the jacket 4.

Before crimping, the outside of the jacket 4 is cylindrical.

After crimping, the outside of the jacket 4 takes the form described in figure 1,

namely that one ogival extremity 11 is connected to an intermediate part in the shape of a truncated cone.

A variant of this method uses a ring of ductile material, a polyamide, for instance, which can be placed in the play gap 16 between the core and the jacket, to improve the smoothness of deformation of the jacket 4, during firing

CLAIMS

1. Perforating projectile (2), specifically for small or medium calibre munitions, comprised of a under-calibrated perforating core (5) of heavy material, centered and held within a jacket (4) of ductile material, with said projectile characterised by the fact that the jacket is crimped on the core by its ogival extremity (11).

2. Perforating projectile (2) as per claim 1, characterised by the fact that the core (5) has a central cylinder (6) extended forward by a conic point (7) and to the rear by a projection in the form of a truncated cone (8).

3. Perforating projectile (2) as per either of claim 1 or claim 2, characterised by the fact that the jacket (4) includes a blind conic bore (10).

4. Perforating projectile (2) as per claim 3, characterised by the fact that the bore (10) has a conic base (9) designed to work in conjunction with the projection in the form of a truncated cone (8) of the core (5) to center the latter within the jacket, with the conicity of the base (9) being the same as that of the projection (8).

5. Perforating projectile (2) as per either of claim 2 or claim 3, characterised by the fact that the bore (10) is oriented in such a way that there exists play between the bore and the central cylinder (6) increasing from the connection rib (15) of the central cylinder (6) and from the conic point (7) to the portion shaped like a truncated cone (8).

6. Perforating projectile (2) according to any of the claims above, characterised by the fact that the exterior of the jacket (4) bears a cylindrical projection (12) designed to accept the grooves from the barrel of an arm, with its diameter effectively equal to that of the diameter of the groove at the base of the barrel.

7. Perforating projectile (2) according to any of the claims above, characterised by the fact that the exterior of the jacket (4) bears an intermediate portion in the form of a truncated cone (13) connected to the ogival extremity (11),

with the largest diameter of this intermediate portion (13) being effectively less than the diameter at the top of the groove of the arm's barrel.

8. Perforating projectile (2) according to claim 7, characterised by the fact that the projection (12) is connected to the intermediate portion in the shape of a truncated cone (13) by a shoulder (14), allowing crimping of a shell case (3).

9. Perforating projectile (2) according to any of the claims 1 to 5 above, characterised by the fact that the core (5) rests against the interior of the jacket (4) held by the connecting rib (15).

10. The assembly process for a perforating projectile (2) according to one of the previous claims, is a process characterised by the fact that after the core (5) is placed in a jacket (4), the core is held away from the extremity of the jacket by a height H of between 1.5 and 2 times its diameter, the crimping of an ogival extremity (11) of the jacket (4) with a crimping punch tool (17) is performed.

11. Assembly process as per claim 10, characterised by the fact that the crimping punch tool (17) can be axially displaced in relation to the jacket (4) to a final crimping position established by a stop (18), with the tool including a bore (19) of the external diameter of the jacket, extended by an ogival profile (20) which guarantees the deformation of the jacket (4) when the tool (17) is pressed upon it.

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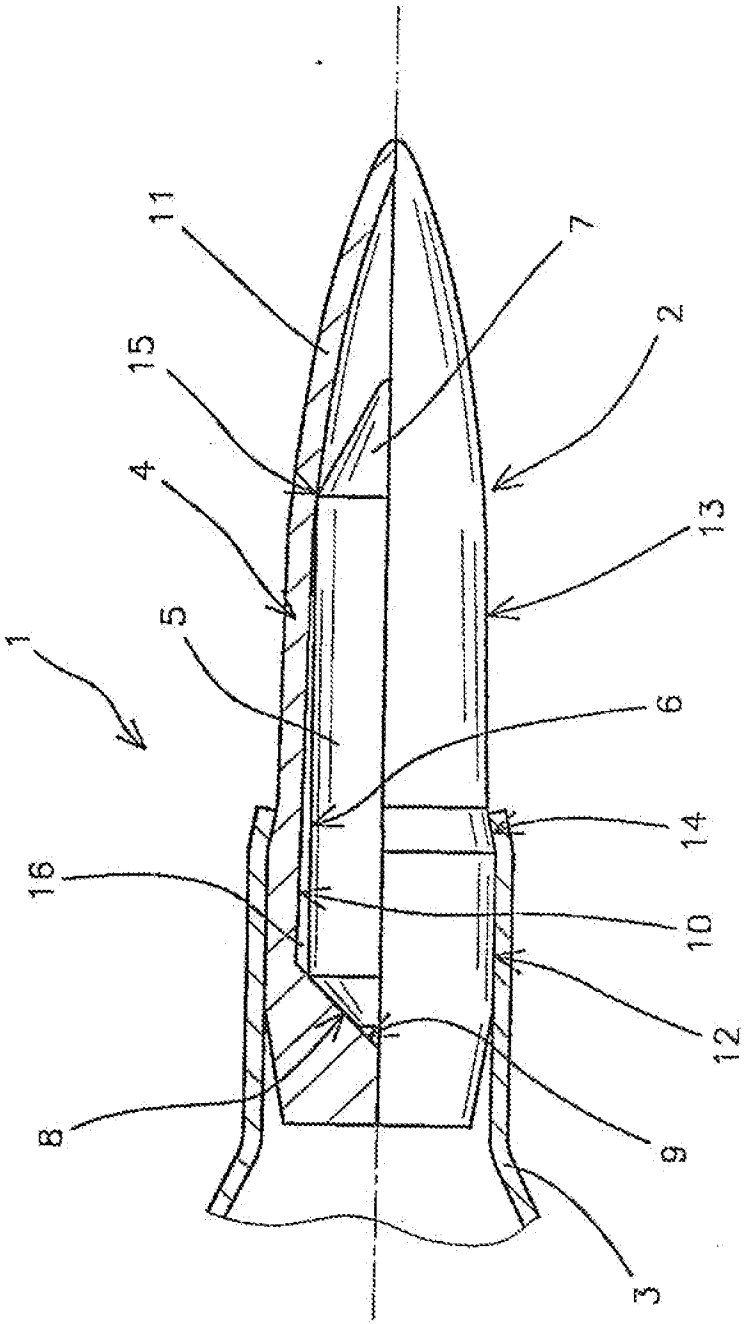

FIG 1

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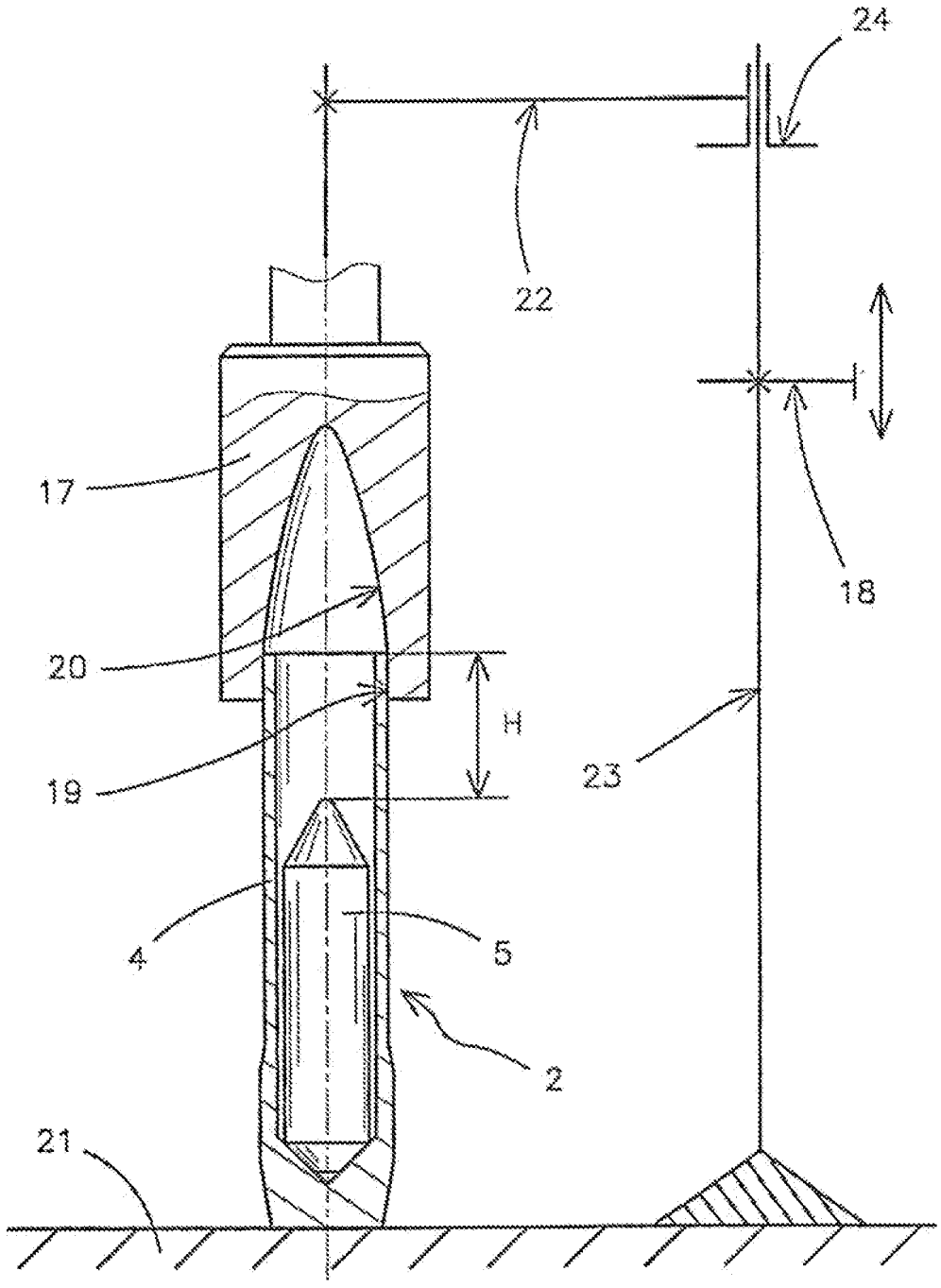

FIG 2

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PRELIMINARY RESEARCH REPORT

Established on the basis of the last claims deposited before research commenced

2821151

National Registry No.

FA 603686

FR 0102165

DOCUMENTS CONSIDERED PERTINENT

Category	Reference to document with indication of pertinent sections, as needed	Claims in question	Classification attributed to the invention by the INPI
X	From 197 30 968 A (LAPUA OY) 19 February 1998 (1998-02-19) *Entire document*	1,2,5	F42B12/06 F42B33/00
Y		3,6,9	
A		10	

Y	From 297 23 236 U (ELISENHUETTE METALLWERK) 18 June 1998 (1998-06-18)	3,9	
	page 5, line 11 – page 6, column 12; Figure 2	6	

Y	US 4 112 846 A (VAN ORDSTRAND CARYL W et al), 12 September 1978 (1978-09-12) *column 3, line 67 – column 4, line 2; figures 1,2 *		
			Technical domains researched (Int.Cl.7)
			F42B

Date research completed	Examiner
October 9, 2001	P. RODOLAUSSE

Category of documents referenced:

X: specifically pertinent on its own
Y: specifically pertinent in combination with another document of the same category
A: technological background
O: non-published disclosure
P: Supplementary document
T: theory or principle underlying the invention
E: patent document of date prior to deposit date and which was not yet published upon deposit date or has a later date
D. cited in the submission
L: cited for other reasons

&: member of the same family, corresponding document

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APPENDIX TO PRELIMINARY RESEARCH REPORT
REGARDING THE APPLICATION FOR FRENCH PATENT No. FR 0102165 FA 603686

This appendix indicates the members of the patent family relating to the patent documents cited in the preliminary research report specified above.
Said members were held in electronic file format at the European Patent Office at the date 09-10-2001.
The information provided is for guidance only and does not commit the European Patent Office nor the French Administration in any way.

Patent document cited in research report	Date published	Member of patent family/families	Date published
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For any information needed regarding this appendix: see the Official Journal of the European Patent Office, No 12/82

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